## Preface

125 [101] In this study, carried out between February and April 1963, seven groups of adult male Orokaiva were tested using a culture-fair test of cognitive ability. There were 20 men in each group, making a total sample of 140.

153 Differences were found between some of the groups; one village obtained significantly higher test results than the other groups and another significantly lower test scores than all others except one.

Some of the total samples were divided into three groups according to productivity or ownership of cash crop trees. There was found to be a significant difference between groups. Those who were most productive tended to have the higher test scores.

128 A principal components factor analysis revealed three factors. Tentative identification suggests a memory factor, a gestalt factor and a less certain third factor.

122 Gratitude is expressed to the New Guinea Research Unit of the School of Pacific Studies, Australian National University, for the financial support which covered field expenses and the cost of travel to Papua.

114 Special thanks are due to Mr Cromwell Burau of the staff of the Unit whose company, assistance and help matched with his special skills made the field work so profitable and enjoyable.

Gratitude is also expressed to Mr I.G. Ord, Chief Psychologist of the Public Service Commission in Port Moresby, for his interest and encouragement in this project. It was his initial research that developed the test and made this project possible.



[p.4 is blank]

125 (iii) Test administration

Testing was done individually during daylight hours at the testees' home villages. The time spent in testing varied considerably depending upon the quality of the response.

123 Establishment of adequate rapport is important in all psychological testing. A number of factors contributed to its establishment in the present case. The field staff and the New Guinea Research Unit were well known to the testees, personally in the majority of cases, and at least by reputation in the remainder. This led to a readiness to co-operate in the research programme. The physical material of the test is itself attractive and appealing. Testees do not become bored or stressed during testing as the item type changes fairly rapidly.

125 A card table approximately 3 feet square was used to provide a flat surface on which testing took place.

(iv) Scoring systems

There are currently a number of scoring systems available for use with this battery. The first of these was devised by Ord (1959). This utilized time bonuses and credit for partially correct responses. Other systems were developed by Kearney (1962). Test scores derived from the different scoring systems were correlated by the product-moment method in a 27 x 27 matrix. When one marking system is correlated with any other marking system for the same test, the correlation did not fall below $r = 0.9$ except in one case where $r = 0.85$.

One system of analysis used simple binaries (i.e., 1 mark if totally correct, 0 marks if incorrect) to avoid any contamination of the results by a marking effect. It might have been thought that delection of time bonuses and part marks would render results less sensitive to small changes in performance, but the above results have not borne this out. There were time limits but these did not make the task rely on speed but were imposed so as to have a standard discontinuation time when the testee was unable to complete the item.

The simple binary system makes no assumption about the relative weightings of various items or ideal time bonuses. In this analysis this system has been used.

## Results

153 The means and standard deviations of the test score are presented in Table 3.

Table 3

153 Means and standard deviations of the test data and rank order of mean test results

| Village or sample | Mean | Standard deviation | Rank order |
|---|---|---|---|
| Beporo | 33.85 | 8.83 | 1 |
| Ex-servicemen settlers | 27.40 | 10.13 | 2 |
| Borugasusu | 23.95 | 7.76 | 3 |
| Inonda | 22.55 | 10.23 | 4 |
| Plantation labourers | 21.95 | 9.14 | 5 |
| Sivepe | 20.50 | 10.24 | 6 |
| Ongoho | 16.25 | 7.97 | 7 |

153 The inter-correlations of all test scores, age and educational
128 background tests are presented in Table 4. The correlation statistic was Pearson's product-moment coefficient.

It must be pointed out that the supplementary data in the last three columns are very rough approximations only. Age had to be estimated, as most testees were unaware of birth dates. Often such events as the eruption of Mt Lamington or the Japanese invasion were used to estimate approximate age. In the initial analysis, age was found to correlate negatively with every other variable. The signs of correlations could be changed, and the variable called 'youth' if so desired. The standard reached at school and the number of years spent at school were also unreliable, but not to the same degree as age.

An analysis of variance was computed to find whether the difference between the groups was significant. The results in Table 5 below show that it was.

The F ratio indicated that there was a real difference between the samples $F = 6.931$ ($p<0.01$); therefore t tests were calculated to investigate which samples were contributing to this significance, i.e., which samples were really different.

The t values are included in Table 6 below.

## Relationship of test score to productivity

153 128 The task of adequately assessing the productivity of each individual proved more difficult than anticipated. The field data forms did not give ready access to information which could be coded or scaled as to productivity. There were considerable differences in the manner in which the various field workers collected and recorded information. There was also a disparity between the sample of the author and that of other research workers. The New Guinea Research Unit was asked to rate the testees for whom information was available. They divided them into three categories of those having more than 500 cash crop trees, those with some cash trees but less than 500, and those without cash crop trees.

Altogether only 46 testees were able to be so categorized. Of these 5 were placed in the first category, 20 in the second category, and 20 in the third category. Another testee who had no trees but was in paid employment as a clerk was placed in the first category bringing the total to 6. The data for these categories are shown in Table 7.

Table 7

Mean test scores for the three categories

| Category | 500 plus trees | 1-500 trees | No trees |
|---|---|---|---|
| Number of testees | 6 | 20 | 20 |
| Mean no. of trees | 1035.6 | 134.3 | 0 |
| Mean test score | 36.0 | 24.5 | 18.4 |
| Standard deviation | 9.62 | 9.34 | 10.63 |

Three t tests were calculated to determine whether the differences between the mean scores were significant. It was predicted that there would be a positive relationship between categories and test score, therefore it was decided to use one-tail tests of significance. The t value between the first and second categories was 2.522 which is significant at $p<0.01$; between the second and third categories, a t value of 1.879 was found which is significant at $p<.05$; and between the first and third categories, a t value of 3.499 was obtained which is significant at $p<0.001$.

A principal components factor analysis was used to examine the factor content of the test. Only the test correlations (the first seven variables in Table 4) were used. Three factors were extracted. These are shown in Table 8.

Table 8

Unrotated factor loadings

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| Test | Factor I | Factor II | Factor III | Communalities |
|---|---|---|---|---|
| Cube Imitation | 80 | -36 | -28 | 85 |
| Bead Threading | - | -22 | 92 | 90 |
| Passalong | 59 | -54 | - | 64 |
| Form Assembly | 83 | 32 | - | 81 |
| Pattern Matching | 68 | 28 | 36 | 67 |
| Kim Game | 72 | -37 | - | 66 |
| Gestalt Continuation | 69 | 63 | - | 88 |
| Variance | 44.8% | 17.0% | 15.4% | |

Decimal points have been omitted and loading of less than 0.20 left blank for ease of reading.

These factors were rotated using the varimax unadjusted method and are shown in Table 9.

Table 9

Factor loading rotated to a varimax unadjusted solution

| Tests | Factor I | Factor II | Factor III | Communalities |
|---|---|---|---|---|
| Cube Imitation | 89 | 21 | - | 85 |
| Bead Threading | - | - | 95 | 90 |
| Passalong | 78 | - | - | 64 |
| Form Assembly | 46 | 77 | - | 81 |
| Pattern Matching | 27 | 69 | 34 | 67 |
| Kim Game | 78 | - | - | 66 |
| Gestalt Continuation | - | 92 | - | 86 |
| Variance | 33.0% | 28.4% | 15.7% | |

Decimal points have been omitted and loading of less than 0.20 left blank for ease of reading.

## Discussion

In this paper the term cognitive ability is used in preference to the more commonly used term intelligence. The latter term has come to have a connotation by common usage which leads to ambiguity. Cognitive ability is used to mean 'thinking' or 'reasoning' abilities in their broader sense.

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121 From the results in the previous section two important facts
153 are evident. Firstly, there is a difference in cognitive ability between the seven samples and, secondly, there is a definite relationship between productivity and cognitive ability.

153 The analysis in Table 6 indicates that the majority of the variation between the samples is caused by the high test scores of the Beporo sample and by the low test scores of the Ongoho sample. The Beporo sample has significantly higher test scores than any of the other samples and the Ongoho sample has significantly lower scores than any other sample except for the Sivepe sample. In the latter case, although there is a difference in the mean or average test score of 4.25, this fails to reach the required significance level and the variation within each of these samples is too large to warrant any conclusion that there is a fundamental difference, although there is a trend in this direction.

The only other difference that is significant is between the ex-servicemen settlers sample and the Sivepe sample. The difference in mean test scores here is 6.90. There are differences between the other samples but these do not reach the required level of significance to be certain that these differences are, in fact, real.

The question then arises as to why the Beporo sample is better than all the others and why the Ongoho sample is poorer than all the others except one. It is not within the scope of this paper
[747] to discuss the possibilities that cause this effect. It is interest-
[177] ing to note that the village of Beporo is situated beside the Gona
[871] Mission which was established approximately sixty years ago. On the other hand, the Ongoho sample have had very little schooling and only one person had spent any time at school. There is an indication that education may have had some influence on the development of these people.

It had often been suggested to the author that people from Beporo were amongst the best workers in the district. The people from Ongoho, on the other hand, have experienced a long history of failures in attempts at communal cash cropping and other ventures. They have not established a clear reputation as they have not participated as fully in the plantation economy as many other villages.

Thus the Beporo people have a record of success and the Ongoho people one of failure. It is suggested that the ability to perform well in the plantation economy may be related not so much to particular opportunities but more to the cognitive ability of the people.

This is brought out more forcibly in the second finding, i.e., the relationship of higher productivity with higher test scores.

153 There were three categories: those who owned more than 500 cash crop trees and were regarded as being highly productive; those who owned less than 500 cash crop trees who were regarded as being in the 'low' to 'medium' productivity range, and those without any cash crop trees (zero productivity). From Table 7 it can be seen that the first category has a mean test score of 36.0; the second category has a mean test score of 24.5 and the third category has a mean test score of 18.4 These scores are sufficiently different from each other (see t tests) for them to be from statistically different groups.

The relationship is not surprising as it would be expected that persons with higher ability would tend to be more productive. The measure of cash crop tree ownership used here is not the best measure of productivity but it does reflect productivity to some degree. If a more accurate measure of productivity had been found the effect might possibly have been more pronounced.

The factor analysis was carried out to allow examination of the factors that the test was measuring. This is an examination of the test rather than of the testees. Three factors were found and those were rotated to a varimax unadjusted solution (Table 9). The interpretation of what the factors represent is not as definitive as the interpretation of other statistical techniques. Below is an attempted interpretation.

The first factor, which accounts for 33 per cent of the variance, loads on all the tests except the Bead Threading and the Gestalt Continuation. It would appear that this is a general memory type factor. This particular ability encompassed the ability to assess the task, learn the goal and then reproduce the information. The tests that gave the highest loadings on this factor were the Cube Imitation, the Passalong Test and the Kim Game. In these tests memory plays an important part, as is obvious in the Cube Imitation and the Kim Game. In the Passalong, the remembering of the correct solution to one item means that the next item is relatively not much more difficult. Each item is a progressive building upon the principles used in the preceding item.

The second factor, which accounts for 28.4 per cent of the variance, loads heavily on the Form Assembly, the Pattern Matching and the Gestalt Continuation tests. It would appear that it is a spatial-closure-Gestalt type of factor. This is the ability to form whole from parts - to synthesize from components.

The Form Assembly requires the completion of a missing area by a combination of shapes fixed to the board. The Pattern Matching requires a testee to make a complex geometric pattern from a number of 1" tiles. The Gestalt Continuation test requires a testee to complete a design by joining dots with a pencil. In all these,

153 there is the ability to visualize the 'whole' and how the parts fit together or to complete the Gestalt.

The third factor which accounts for 15.7 per cent of the variance presents a more difficult task of interpretation. Because it has a very high loading on the Bead Threading test and only a smaller loading on the Pattern Matching and an absence of any loadings on all other tests, it is indicated that the factor is almost specific to the Bead Threading test. It could perhaps be associated with some type of manipulative ability, i.e., threading the beads or manipulating the tiles. Definite conclusions cannot be drawn at this stage.

153 121 From the factor analysis, the structures of the elements of cognitive ability measured by the tests emerge more clearly. This is due to the use of more accurate statistical methods than an a priori assumption that each test measures some particular aspect of cognitive functioning. The overall ability level of the seven samples and the three categories are therefore seen in more detail.

The interlocking matrix of cognitive ability is complex but some elements of this are measurable. They do reflect the variation in ability from person to person. People also vary in other facets of behaviour and one examined here in a crude and simple form is productivity in the cash crop economy. The relationship of these abilities has been demonstrated. It would have been better if a more intricate and exacting measure of this productivity had been obtained. Even though productivity is sometimes related to specific influences such as economic, agricultural or even social fluctuations, these may be beyond the control of any particular person. There is also a level of cognitive ability specific to a person that tends to influence the outcome of his personal endeavour.

It would be foolish to assume that all high producers are of necessity of a high level of cognitive ability or that all low producers are of low cognitive ability. However, the trend is clear and significant.

It is often the case that external influences are circumscribed in their effect on agricultural outcome and that personal attributes such as individual cognitive ability are thought to be of only minor importance.

The ability to differentiate between successful and non-successful categories implies the ability to predict such categories and therefore select with higher probability than chance those who are likely to succeed in any venture.

Economic, agricultural and other external influences are important as are individual, social and internal emotional

153 121 influences. Motivation is of considerable importance but tends to be confused. It is easier for a person to say that he won't do something than to say that he can't. This is certainly the case in the European culture where being poorly motivated is more acceptable than being of poor cognitive ability. The former state can be altered from time to time but the latter state is relatively unchangeable.

It is suggested that in those cases where there is a need to choose between a number of applicants, those with the greatest probability of success should be selected. Close attention should be paid to the individual's cognitive ability and this, together with knowledge of other background and environmental influences, can increase the possibility of success in any selective procedure.

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472 to the Northern District none has lived within a village community in the way almost all Orokaiva live today. Their houses are built on their farms adjacent to their cash crops rather than in a village. The farms of A and B are within half a mile of their villages but C's farm is two miles away, while D, occupying a resettlement block, is nearly a hundred miles from his home village. (There were no resettlement schemes closer at the time.) The first three men were joined in their new houses by relatives, in addition to their own nuclear families, who lived with, or adjacent to, them and assisted in the cash-cropping.

472 464 The four entrepreneurs had engaged in paid work for periods ranging from twelve to twenty-five years, with an average of seventeen. This is considerably longer than the average for village Orokaiva,[1] and the entrepreneurs have each been engaged in a much wider range of occupations than ordinary villagers.

472 The work experience of one of the successful entrepreneurs, B, had been mainly in cash-cropping activities, but the other three had had little such experience and none of them had any experience or training in retail trading. On the other hand, all four had held posts involving considerable responsibility over people and property.[2]

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472 554 153 A factor which can only be a matter of conjecture at this stage, is that all four men appear to have drawn on the example of specific persons as models for their actions. Their aspirations to higher consumption standards, better housing, motor vehicles, education for their children, etc., appear to be very similar to those of the village Orokaiva people with whom I have worked. The main difference seems to be that most village people regard these goals as largely unattainable by methods at present open to them and are still seeking a clearer 'way' or 'road' to prosperity, whereas the four entrepreneurs have seen their goals as attainable by drawing on the models known to them from personal experience.[3] This is not to suggest that they have clear-cut or well formulated plans for development, nor that they are familiar with the economics of

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[1] Household heads at Inonda had spent an average of ten years in paid employment (Crocombe and Hogbin 1963b:59) and at Sivepe six and a half years (Rimoldi 1966:82).

[2] Their positions have included cook, labour recruiter, charge over food and equipment stores, foreman of plantations, of a coffee factory and of an oil exploration team, and police sergeant.

[3] In all four cases the models were European, but in the case of Numbuk of Erap (Crocombe and Hogbin 1963a:1) the model was a successful New Guinean entrepreneur. [177]

472 554 153 marketing or the more intricate techniques of production. It does suggest, however, that they have a sufficiently clear conception of the way to achieve the goal (and the way is more important than the goal itself) to enable them to organise and to act. It is apparent that the entrepreneurs studied were highly motivated.[1]

Land and food gardens

241 423 [428] [472] Most Orokaiva men established their cash crops on customary land to which they have acquired rights by inheritance from their fathers. None of the entrepreneurs did so, though all claim that they could have done had they wished but deliberately chose not to. Each stated that the reason was to avoid claims by kin to their land, produce or income.

241 423 472 A had cleared bush land and planted coffee at Garara where his close kin had been permitted to resettle in the late 1920s. Though the host clan did not mind the newcomers planting food crops they objected to cash crops and forced him to abandon it. About 1930 the newcomers purchased about 2,000 acres of virgin bush land at Kapurahambo from the clans of Soputa. The transfer was accompanied by a series of feasts and dances and the distribution of traditional valuables. The land was divided among the buying group, A and his two brothers being allocated an area of eighty-one acres on which they have since planted cocoa and coffee. A has applied for registration of his land under the [656] Land (Tenure Conversion) Ordinance 1963.

B claims he had extensive customary land available to him and this is confirmed by other villagers. But for his cash crops (coffee and cocoa) he chose to clear an area of unoccupied bush land which had formerly been owned by a small group which had been decimated and the survivors scattered decades before. B thought he would acquire exclusive rights to the area he cleared (Crocombe and Hogbin 1963b:72-3). He subsequently improved the security of [656] his title by registering this land under the Higaturu Council land registration scheme, a transitional scheme, now superseded. He has since applied for registration under the 1963 legislation.

C has rights to hundreds of acres of customary lands. For his [432] cash-cropping, however, he chose to use two adjacent blocks of a total of 106 acres which had been purchased by the government for European settlement in the 1920s for 54 pounds of tobacco, one tomahawk and one knife. The European lessor planted coconuts but abandoned the property before the second world war. Though legally

[1] A better understanding of this aspect will be achieved by research to be undertaken in 1967 by Ruth Finney of the University of California.